UNIVERSITI TEKNIKAL MALAYSIA MELAKA

IOT SMART DOOR LOCK

This report is submitted in accordance with the requirement of the Universiti
Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Electrical
Engineering Technology
(Industrial Automation & Robotics) with Honours.

by

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This report is submitted to the Faculty of Eletrical Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours. The member of the supervisory is as follow:

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ABSTRAK

Kertas ini mencadangkan penggunaan IoT (Internet of Things) sebagai medium untuk sistem kunci pintu untuk automasi keselamatan rumah. Sistem kunci pintu pintar adalah bentuk sistem kunci yang membolehkan pengguna mengawal sistem kunci pintu dari jauh dan serentak dapat memantau pelawat di pintu. Dalam sistem ini, mikropontroller model B Raspberry Pi 3 digunakan sebagai pusat pemprosesan utama yang bertindak sebagai pengawal utama sistem keselamatan keseluruhan. Sistem kunci pintu yang dicadangkan terdiri daripada penggunaan peranti telefon pintar pengguna yang dijalankan pada OS Android atau Apple iOS yang bertindak sebagai media kawalan untuk mengunci atau membuka kunci sistem keselamatan jauh. Pengguna juga dimaklumkan mengenai status sistem keselamatan apabila dikunci atau dikunci. Selain itu, ia membolehkan pengguna untuk melihat persekitaran rumah jauh melalui Internet.

ABSTRACT

This paper proposed the use of IoT (Internet of thing) as medium for door lock system for home security automation. A smart door lock system is the form of lock system that allows user to remotely control the door lock system while simultaneously able to monitor visitors at door. In this system, a Raspberry Pi 3 model B microcontroller is used as the main processing central which acts as the main controller of the overall security system. The door lock system proposed consists the use of user's smartphone device running on Android OS or Apple's iOS which acts as the control medium to remotely lock or unlock the security system. Users are also notified of the status of the security system when its locked or unlocked. Furthermore, it allows the users to remotely observe the home environment through the Internet.

DEDICATION

I dedicate this project to my beloved family, who has always encouraged and supported me through all the way and made sure that I gave my all in completing when this all started. I also dedicate this both of my supervisors, Ms. Suziana bt Ahmad and Ms. Madiha bt Zahari, who has guided me throughout the work of all this project and provided me the inspiration, wisdom, knowledge, and understanding of this work.

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INTRODUCTION

1.0   Background

The Internet of Things (IoT) is a network of physical devices, vehicles, home appliances and other items embedded with electronics, software, sensors, and connectivity, enabling these objects to connect and exchange data or information. Every individual is uniquely identifiable through its embedded computing system but is able to inter-operate within the existing internet infrastructure.

Over the year, this technology is slowly becoming an integrated part of people's lives. It has continued to influence many aspects of daily life and has allowed better social interaction, ease of transportation, the ability to indulge in entertainment and media, and has helped in the development of medicine. The creation of many devices such as mobile phones and computer have caused may people to rely on technology to communicate, store information, entertain, and has improves the people's lifestyle by allowing them to have the ease of access to all the above.

From the time of its introduction, the amount of people that use mobile phones and the internet has increased dramatically to become one of the major means of communication. Smartphones allow people to connect to the internet without the use of computer, while still offering the same functionality through different means. With introduction of better software and better hardware, smartphones have become a powerful device that plays an important role of people's live.

As technology develops, the demands of new products and services to make life efficient grow. In today's world, people always remain busy in their day to day work. Sometimes they tend to forget their necessary like keys when leaving for work. At the same time, they also want to ensure the safety of their beloved belonging at home. The use of IoT can allow people to communicate with their home appliances, such as security system, with the use of smart device such as smartphone, to help ensure the safety of their belonging at home.

1.1 Problem Statement

Home security has always been an issue for people, especially for people who are not always available at their home, children, people of old aged, and physically challenged people. Incidents like robbery, stealing, or unwanted entrance can happen unexpectedly. This can cause issue to people who are not convenient to encounter such problems.

Different type security system had been invented before the IoT era, such as password-based system or smart card-based system. This system provides convenient to user such that home is secure through the help of constant surveillance of security company and alarm system to alert when intrusion happens. But these types of security system are a subscription-based system, in which users are required to pay monthly fee to ensure the system to be online. These systems can only be managed at door steps, which means they can only be unlock at doors, requiring password or a smart card. If the unlocking method of such system were obtained by other people, they may be able to breach through user's home without alerting the alarm system.

However, the implementation of IoT with security system allows user to be connected to their home whenever they are in range of internet connection, and since in today's world internet is globally available, it means they are always aware of their system. A smart security system allows user to connect and interact with their home security, allowing them to control and monitor their home with ease, whenever, wherever. A surveillance system can be installed and connected as well to view visitors at door from their smart devices. Door locking and unlocking can also be done from any distance as long users of this system is connected to the internet. An alarm system can also be implemented into the system to alert users through their smart devices so they can call for help almost immediately when problems occur.

1.2   Objective

In the construction and completion of this project, there are several objectives

- To create a security system based on the use of Internet of Things (IoT)
- To apply the created security system with an Android smart device
- To analyse the outcome of the use of IoT in security system

1.3   Project Scope

For this project, scope has been set for smooth running of this project that is not excluded from the guidelines that have been made. Amongst them are:

a. Android smart phone
- Android smart phone will be the communication platform between user and the security system.

b. Raspberry Pi

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- To enable the connection between the user through smart phone and the security system, Raspberry Pi is used as the microcontroller to communicate between all the inputs and outputs of the system.

c. Raspberry Pi camera module

- To provide live feed video from the security system to the user, can be supported in 1080p/720p/640x480p video.

CHAPTER 2

LITERATURE REVIEW

2.0   Introduction

There is a lot of different definition to automation. According to [1], it is the use of control system to operate equipment without or with lesser human intervention. This process helps to save time and energy for human to reduce manual labour and improve time spent on developing ideas to improve system. In [2], it is mentioned that with door locks available in the market, people remain unsatisfactory to the flexibility of a door lock. The conflicting needs of improved security, convenience and continuous control of the system, leads people to seek solutions through conventional method. Hence the application of automation into home system help in improving the life efficiency. One of the area people had most interest in is the door lock system. There had been many projects of smart door lock and home automation proposed used with different type of communication technologies such as Bluetooth, Zigbee, and Wi-Fi. The comparison of such communicating technologies will be discussed in this chapter.

Furthermore, this chapter will cover on the hardware component that will be used and how it is implemented into the project. Comparison of the available microcontroller such as Raspberry Pi and Arduino shall be discussed as well.

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2.1 Wireless Technologies

In [3], it is mentioned that home automation is a concept where household appliances are connected to the Internet and to be monitored and/or controlled through smart devices or web application. The most important element of home automation is the communication method used to connect and/or remotely control these devices at home. There are two types of approach, which is the wired connection and wireless connection. Although wired home network was typically used in the earlier developments of home automation, but wireless connection offers a more efficient connection and cleaner design to home network. Therefore, this project proposes the application of wireless communication to the device, but there are a few types of option such as Zigbee, Bluetooth, and Wi-Fi internet connection

2.1.1 Zigbee

According to [4], Zigbee is built on top of IEEE 802.15.4 standard, in which the standard defines the operation of low-rate wireless personal area networks (LR-WPAN). It specifies the characteristics of the physical layer and Medium Access Control (MAC) layers for Wireless Personal Area Network (WPAN).

It works with three type of frequencies: 868 MHz (Europe, 20kbps), 915 MHz (USA and Australia, 40kbps), and 2.45GHz (World, 250kbps) and it conceives of a 10-meter communication range [3].

Based on research journal [4], it is mentioned that Zigbee was widely used in the previous wireless home automation system, but since it offers limitation to its communication range, most of its project only focuses primarily within house range only.
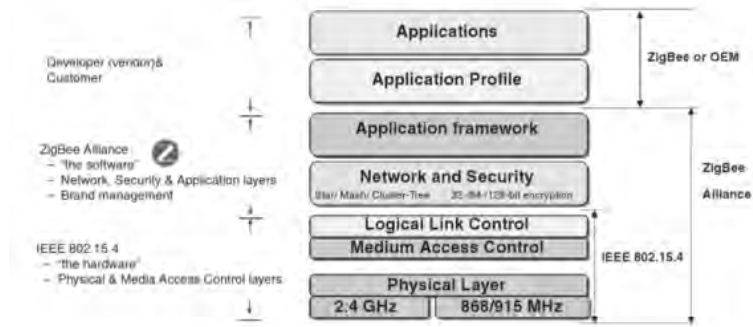
Figure 2.1 Zigbee Protocol Stack [3]

2.1.2 Bluetooth

Bluetooth provides better communication range when compare with Zigbee. Its is a PAN technology developed by Ericsson based on 802.15.1 standard. Based on [3], it was mentioned that Bluetooth has been developing towards IoT focusing on privacy, security and energy-efficiency.

Bluetooth connection has two types of system: Basic Rule (BR) and Low Energy (LE). Data transmission rates vary from BR's 721.2kbps to 2.1Mbps and with Enhanced Data Rate up to 52Mbps.

Bluetooth has two roles: a master and slave. Master can have multiple slaves connection while slave can only have one master connection, and due to this form of role connection it has a disadvantage of incurring access delay to share communication.

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2.1.3   Wi-Fi

Since the day of internet boom, Wi-Fi connection has become an essential part of every days' life, be it personal and/or professional, and is constantly improving our efficiency and communication. This communication technologies provides advantages that other communication technologies could not have achieved. It lowers installation cost and it comes with the integration of smart device such as smart phones, making automation system possible anywhere and anytime.

According to [3], Wi-Fi uses electromagnetic waves to communicate data that runs at two main frequencies: 2.4Ghz (802.11b) and 5Ghz (802.11a), which provides data transmitting rates up to 600 Mbits/s.

Since this project proposed the system to be functional at all time, Wi-Fi provides great flexibility with the integration of smart phone in use to connect to the home automation server[5]. This helps to reduce the deployment cost and provide the ability to upgrade and/or reconfigure system. The use of Wi-Fi protocol (IEEE 802.11a/b/g) ensure longer distance communication when compare to other technologies.

According to [6], Wi-Fi technology is already widely used in today's technology and is still ever growing in the market, making it available for people to connect to home automation server at all time and at anywhere where internet connection is available.

2.1.4 Comparison

Below there is a Table 2.1 from multiple sources and especially with range there was slightly deviation between the sources. This comparison takes wireless connection between hardware components and smart phone into consideration. From the table we can see that Wi-Fi provides the best data transferring rate and distance. Wi-Fi connection also reduces the sophistication architecture and provides the ability to incorporate with modern device for network management purpose and provision of remote access. Zigbee and Bluetooth connection is no suitable for home automation in this case due the limit of the data transmitting range, low communicating frequency, and the complexion of installation of these technologies.

Name	Wi-Fi	Zigbee	Bluetooth
PHY/MAC standard	IEEE 802.11n	IEEE 802.15.4	IEEE802.15.1
Network topology	Star, mesh	Tree, star, mesh	Star
Network size	2007	65536	8
Maximum data rate	600 Mbps	Up to 250 kbps (2.4GHz)	1 Mbps
Radio Frequency band(s)	2.4 and 5 GHz	868.0-868.6 MHz, 902-928 MHz and 2.4-2.4835 GHz	2.4 GHz
Range	70m indoors and 250m outdoors	10-100m	5-100m
Error control/Reliability	32-bit CRC	16-bit CRC, ACK, CSMA-CA	16-bit CRC
Transmit power	722.7mW	52.2mW	72mW
Security	WPA2, EAP, TLS/SSL	AES-128	AES-128

Table 2.1 Comparison Table[3]

2.2 Microcontroller

A microcontroller is defined as a small computer on a integrated circuit. It functions as the 'brain' of a control system, processing input and output, transmitting data to designated point. In [7], it is mentioned that the microcontrollers consist of RAM, ROM, and I/O on chip.

To communicate between the proposed system and smart device, and medium such as the microcontroller should be included in the project to help transmit data between system and smart phone.

2.2.1 Arduino Uno

According to [8], Arduino is a microcontroller that can be easily programmed, erased, and reprogrammed to control system. In [9], it is mentioned that Arduino ATMEGA-328 (commonly known as Arduino Uno) has 14 digital input/output pins (6 of which can be used as PWM outputs), 6 analogue inputs, a 16MHz crystal oscillator, a USB connection, a power jack, and ICSP header, and a reset button.

The software used to program the device is Arduino Software IDE, which runs on C++ language as its programming language. Figure 2.2 shows the Arduino Uno board.

Figure 2.2 Arduino Uno Microcontroller [9]

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2.2.2 Raspberry Pi (Model B)

The Raspberry Pi is a small credit card sized computer, function almost as similar as the regular computer people know, which runs on Linux operating system. According to [10], the Raspberry Pi has a broad com BCM 2835 SoC, which comprises of an advanced RISC Machine 76JZF-S 700 MHz processor, video core IV GPU, and was originally distributed with 256 megabytes of RAM, and later upgraded (Model B & Model B+) to 512 MB. It does not come with a hard disk or solid-state drive, but it uses and SD card for booting and data storage.

Raspberry Pi uses Python as its main programming language with support for C, C++, Java, Ruby, and Perl.

Raspberry Pi also comes with GPIO pin which is known as general-purpose input/output ports for connection. It comes in 40 pins (Raspberry Pi 2 Model B) and each pin has its own function and can be address to function. Figure 2.3 below shows the Raspberry Pi board representation.

Figure 2.3 Raspberry Pi Board Representation[17]